Description

Method and radio communication system for transmitting payload information as a service to a plurality of subscriber stations

The invention relates to a method for transmitting payload information in a radio communication system having at least one radio network controller, at least one base station and at least one subscriber station in accordance with the preamble of Claim 1.

The invention also relates to a radio communication system in accordance with the preamble of Claim 11.

Communication systems are becoming increasingly important. Significant efforts are being made to link cable-based communication systems to radio communication systems. The resulting hybrid communication systems generate an increase in the number of available services, but also allow greater flexibility in terms of communication. At the same time, devices are being developed which can use various systems (multi-homing).

Considerable importance is attached to the radio communication systems due to the subscriber mobility which is made possible.

In radio communication systems, information (e.g. voice, image information, video information, SMS [Short Message Service] or other data) is transmitted with the aid of electromagnetic waves via a radio interface between sending and receiving station (base station or subscriber station). In this case, the emission of the electromagnetic waves takes place using carrier frequencies which lie in the frequency band which is provided for the relevant system.

Frequencies of 900, 1800 and 1900 MHz are used for the GSM (Global System for Mobile Communication) mobile radio system that has been implemented. These systems essentially transfer voice, fax and SMS (Short Message Service) short messages, as well as digital data.

Frequencies in the frequency band of approx. 2000 MHz are provided for future mobile radio systems using CDMA or TD/CDMA transmission methods, e.g. UMTS (Universal Mobile Telecommunication System) or other third-generation systems. These third-generation systems are developed with the aims of worldwide radio coverage, a large offering of services for data transmission and, most importantly, flexible management of the capacity of the radio interface, which is the interface with the fewest resources in radio communication systems. In the context of these radio communication systems, the flexible management of the radio interface should primarily allow a subscriber station to send and/or receive a large amount of data at high data speed as required.

The access of stations to the shared radio resources of the transmission medium, e.g. time, frequency, throughput or space, is governed by multiple access (MA) methods in these radio communication systems.

In the case of time division multiple access (TDMA) methods, each send and receive frequency band is divided into time slots, wherein one or more cyclically repeated time slots are assigned to the stations. Using TDMA, the radio resource of time is separated in a station-specific manner.

In the case of frequency division multiple access (FDMA) methods, the whole frequency band is divided into narrow-band portions, wherein one or more narrow-band frequency bands are assigned to the stations. Using FDMA, the radio resource of frequency is separated in a station-specific manner.

In the case of code division multiple access (CDMA) methods, the throughput/information which has to be transmitted is encoded in a station-specific manner by means of a scrambling code which consists of a multiplicity of individual so-called chips, whereby the throughput which must be transmitted is scrambled randomly over a wide frequency range in accordance with a code. The scrambling codes which are used by different stations within a cell/base station are mutually orthogonal or essentially orthogonal in each case, whereby a receiver recognizes the signal throughput which is intended for said receiver and suppresses other signals. Using CDMA, the radio resource of throughput is separated in a station-specific manner by means of scrambling codes.

In the case of orthogonal frequency multiple access methods (OFDM), the data is transferred in a broadband manner, wherein the frequency band is divided into equidistant orthogonal subcarriers, such that the simultaneous phase shifting of the subcarriers covers a two-dimensional data flow in the time-frequency range. Using OFDM, the radio resource of frequency is separated in a station-specific manner by means of orthogonal subcarriers. The combined data symbols which are transferred on the orthogonal subcarriers during a time unit are called OFDM symbols.

The multiple access methods can be combined. In this way, a multiplicity of radio communication systems use a combination of the TDMA and FDMA methods, wherein each narrow-band frequency band is divided into time slots.

For the purpose of the aforementioned UMTS mobile radio system, a distinction is made between a so-called FDD (frequency division duplex) mode and a TDD (time division duplex) mode. In particular, the TDD mode is characterized in that a shared frequency band is used for the signal transmission in both

uplink (UL) direction and in downlink (DL) direction, while the FDD mode uses a different frequency band for the two transmission directions in each case.

In radio communication connections of the second and/or third generation, information can be transmitted in a circuit-switched (CS) or packet-switched (PS) manner.

The connection between the base station, of which there is at least one, and the subscriber station, of which there is at least one, takes place via a radio communication interface. The base station can support a plurality of radio cells in this case.

The base station, of which there is at least one, and a radio network controller (RNC) are usually components of a base station subsystem (RNS radio network subsystem). A radio communication system normally includes a plurality of base station subsystems which are connected to a core network (CN). The radio network controller of the base station subsystem is connected to an access facility (SGSN Serving GPRS Support Node) of the core network in this case.

In addition to individual items of payload information, radio communication systems transmit data which is made available to a plurality of users. Such items of payload information include, for example, video streams or other items of broadcast and/or multicast information. The services for transmitting items of payload information which are not merely intended individually for a single subscriber, but are made available to a plurality of subscribers,
are grouped under the term MBMS (Multimedia Broadcast/Multicast Service). Different MBMS (Multimedia Broadcast/Multicast Service) services are usually provided as separate data streams by the core network.

Before the items of payload information are made available as a service to a plurality of subscribers, a notification takes place in relation to the subscriber stations of those subscribers who want to use the service, before the actual transmission of the items of payload information of the service. This notification of the subscriber stations is necessary so that the receivers can be configured. Depending on the mode of the subscriber stations (e.g. "connected mode" or "idle mode"), they are notified by means of a "notification" or "paging", for example. Group-specific mechanisms are normally used for notification, wherein a plurality of subscriber stations are addressed simultaneously.

The transmission of items of broadcast/multicast information as services should take place advantageously. In particular, any avoidable utilization of radio resources should be avoided whenever possible.

The invention therefore addresses the problem of setting forth a method and a radio communication system of the type cited at the beginning, which satisfy these specifications.

The problem is solved by the features in Claim 1 for the method and by the features in Claim 11 for the radio communication system.

Advantageous configurations and developments are subject matter of the dependent claims.

In accordance with the invention, the notification to the subscriber stations of the subscribers includes in at least some cases a request for a reply, and the transmission of the payload information takes place in at least some cases following receipt of the reply.

The invention assumes that usually the subscriber stations of subscribers who use MBMS services are not uniformly distributed in the radio network. In most cases, therefore, there will also be areas in the radio network where transmission of the payload information of the MBMS services is unnecessary because no receiving subscribers are present there. Therefore, if no reply is received on the network side in response to a request for a reply within the context of a notification to the subscriber stations of the subscribers of an MBMS service, the transmission of the payload information does not take place in at least some cases. In this way, radio resources are not occupied unnecessarily.

The invention takes advantage of the fact that subscriber stations of the subscribers who use the MBMS service need not be present in all radio cells of the radio communication system. In principle, therefore, it is possible to avoid any unnecessary transmission of payload information in the radio cells or sectors of radio cells where a request to the subscriber stations was not followed by a corresponding reply.

The subscriber stations are advantageously grouped into groups with regard to the notification. In particular, an identical notification can be sent to a group of subscriber stations of the subscribers. Due to the radio network architecture which is already present, it is particularly beneficial if the grouping of the subscriber stations takes place with reference to their assignment to radio cells. It is then particularly easy to incorporate the invention into existing systems.

In accordance with the invention, the notification to the subscriber stations of the subscribers - as explained above - includes a request for a reply in at least some cases, i.e. at least some subscriber stations or at least one or more groups of subscriber stations receive a request for a reply. In this case, a configuration of the invention provides for the

notification to the subscriber stations of the subscribers to include either a request for a reply or an information item indicating that no reply is necessary, wherein the transmission of the payload information takes place independently of a reply in the latter case.

In this type of configuration, for example, a request for a reply might be omitted in radio cells which supply a hotspot, because it is very probable that, due to e.g. the high density or large number of subscriber stations, at least one of the subscribers who use the offered MBMS service will be present. By virtue of the fact that no request for a reply is sent in this case, not only radio resources are saved, but also unnecessary delays in the transmission of MBMS services can be avoided. It is possible effectively to avoid overload situations in the case of access to shared resources in the uplink, e.g. if a large number of subscribers using MBMS services are in a radio cell, which overload situations would otherwise occur if a reply was requested from a very large number of subscribers.

The subscriber stations or the groups of subscriber stations are informed, by means of a corresponding information field in the notification, whether they are expected to send a reply or not. The request for a reply (RESP) or the information indicating that no reply is necessary can be transmitted in the form of a bit (e.g. "response" bit).

In a development of the invention, at least one decision criterion is used to establish whether a notification including a request for a reply or including the information that no reply is necessary is transmitted from the radio network controller to the groups of subscriber stations of the subscribers. This is preferably established in the radio network controller in this case.

A static and/or dynamic decision criterion can be used in principle, but it must be a radio network-specific decision criterion. The decision whether a notification is to include a request for a reply or the information that no reply is necessary can be adapted according to the static and dynamic conditions e.g. in a radio cell.

The decision criterion can take into consideration, for example, the configuration of the radio network, existing knowledge on the radio network side about subscribers, the utilization of the radio resources (e.g. a large number of subscribers who use the shared resource in the uplink) in the radio network or in areas thereof, specific properties of the service (e.g. frequency and duration of the transmission), or a combination of the aforementioned possibilities. In this context, information about the configuration can be supplied by the operations and maintenance center (OMC), for example.

In a development of the invention, the replies of the subscriber stations of the subscribers from whom a reply has been requested, and in particular the replies of the subscriber stations within a group of subscriber stations, are not transmitted concurrently. This measure also contributes effectively to a temporally distributed use of radio resources.

The replies of the subscriber stations of the subscribers from whom a reply has been requested, and in particular the replies of the subscriber stations of a group, can be transmitted at random or preferably in a controlled manner with regard to the time of transmission.

The transmission of payload information for a group can advantageously take place following receipt of the reply of at least one subscriber station of the group. This prevents delays and also saves radio resources. For in the context of the request for time-staggered replies from the subscribers, those

subscriber stations wanting to transmit their reply after the receipt of a reply from a first subscriber station can be informed, for example as part of the start of the transmission of the payload information of the service or as a result of the start of the transmission of the payload information of the service, that a reply is no longer necessary.

The claimed radio communication system provides means such that the notification to the subscriber stations of the subscribers includes a request for a reply in at least some cases, and such that the transmission of the payload information takes place following receipt of the reply in at least some cases.

The radio communication system can include means such that a notification is sent to groups of subscriber stations of the subscribers.

Means can be provided for establishing, on the basis of at least one decision criterion, whether a notification including a request for a reply or including the information that no reply is necessary is transmitted from the radio network controller to a group of subscriber stations of the subscribers. These means are preferably situated in the radio network controller (RNC). The radio network controller is then expanded to include a function which analyzes whether, e.g. on the basis of the specific configuration of a radio cell, a reply should be requested or not.

The described radio communication system is particularly suitable for carrying out the method according to the invention. Corresponding means and entities can be present in the radio communication system or its individual components in each case for carrying out the method and its configurations and developments.

The invention is explained in greater detail below with reference to exemplary embodiments and two figures, in which:

Figure 1 shows a schematic illustration of a radio communication system according to the invention,

Figure 2 shows a schematic illustration of a flow diagram for the transmission, as claimed in the invention, between core network, radio network controller, base station and subscriber station.

Figure 1 shows a schematic illustration of a radio communication network for a transmission, in accordance with the invention, between a radio network controller RNC, two base stations NodeB1 and NodeB2, and mobile subscriber stations UE1, UE2, UE3, UE4, UE5 and UE6.

The radio network controller RNC is connected on one side to an access facility of a core network CN and on the other side to the two base stations NodeB1 and NodeB2. Base station NodeB1 serves the radio cells A and B and base station NodeB2 serves the radio cells C and D. The subscriber stations UE1 and UE2 are situated in the radio cell B. The subscriber stations UE3, UE4, UE5 and UE6 are assigned to the radio cell C.

In the radio cell B of the base station NodeB1, the mobile subscriber station UE2 is to receive an MBMS service which can be signaled via a group control channel, for example, by the radio network controller RNC via the radio cell B using the radio communications interface. The notification in the radio cell B includes a request for a reply. Subscriber station UE1 is not currently interested in using an MBMS service. After the subscriber station UE2 has responded to the request in the notification by sending off a reply, the transmission of the payload information of the service begins in the radio cell B.

In this case, the payload information of the service is transmitted over a traffic channel, for example.

Provision is likewise made to transmit an MBMS service in the radio cell C. Radio cell C supplies a potential hotspot, for example. On the basis of this knowledge, the radio network controller RNC dispenses with a request for a reply within the radio cell C, since a larger number of users is anticipated for the MBMS service here. In radio cell C, therefore, payload information of the MBMS service is transmitted without delay to the base station NodeB2 via the radio communications interface and by the mobile subscriber stations UE3, UE4, UE5 and UE6. In the case which is shown here, the subscriber stations are grouped on the basis of their assignment to the radio cells.

No subscriber stations are shown in the radio cells A and D.

Figure 2 shows a schematic illustration of a flow diagram for the transmission, as claimed in the invention, between core network CN, radio network controller RNC, base station NodeB and subscriber stations UEn.

The radio network controller RNC receives the message NOTIF-1 via an access facility of the core network CN, said message indicating that payload information of an MBMS service should be made available to subscriber stations UEn.

With reference to the exemplary embodiment which is described in connection with Figure 1, the MBMS service is to be made accessible to e.g. the subscriber station UE2 in the radio cell B of the NodeB1 and to the subscriber stations UE3, UE4, UE5 and UE6 in the radio cell C of the NodeB2 from Figure 1. In this case, the radio network controller RNC makes the decision DECIS that the notification NOTIF-2 to the subscriber station UE2 contains a request for a reply RESP, and that the notification NOTIF-2 to the subscriber stations UE3 to UE6

includes an information item indicating that no reply is necessary. In the radio cell B of the base station NodeB1, a transmission of the payload information of the MBMS service then takes place following receipt of the reply RESP. In the radio cell C of the base station NodeB2, the transmission of the payload information takes place independently of a reply RESP.